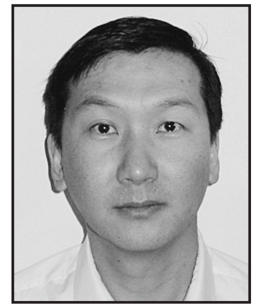
Session 11 Overview

TV Tuner / RFID



Chair: David Su, *Atheros Communications, Santa Clara, CA*

Associate Chair: Bud Taddiken, *Microtune, Plano, TX*

We are in the early stages of a worldwide transition in television broadcasting from analog to digital. In a few places in the world, analog broadcasts have already been switched off; however, most of the world will still require support for legacy broadcasts through 2009, 2012, and even 2015. During this transition period, it is necessary to support both the legacy analog TV standards – NTSC, PAL, and SECAM – as well as the new digital TV standards – DVB-T, ISDB-T, and ATSC. Because of this transition, there will be a multi-year increase in the unit volume shipments both for digital TVs that incorporate both digital and analog reception and also for converter boxes that accept a digital TV input and convert it to an analog TV output for display on a legacy analog TV. The technical challenges for receiving analog or digital TV broadcasts are different, and the challenges increase when both must co-exist. In addition to the technical challenges, the cost of the solution must also be made very low for wide market adoption. Today, almost all TV sets and off-air set-top converter boxes still use surprisingly low-cost tuner modules consisting of hundreds of discrete components and requiring manual tuning (frequency alignment). The first three papers in this session present highly integrated TV tuners to meet both the technical and commercial challenges of the digital TV transition around the world.

Up until now, highly integrated silicon TV tuners have employed dual (up-down) conversion, low IF, and – in the case of some mobile TV applications – even direct conversion when the input frequency range was narrow enough to avoid harmonic mixing of large interferers. Paper 11.1 from Chrontel and UCSD is the first publication of a direct-conversion TV tuner that covers the full 48-to-860MHz TV bandwidth and solves the harmonic mixing problem. For this highly integrated design, all necessary filtering is included on the 0.18µm CMOS chip: good image rejection is achieved and power consumption is 750mW. A SiP solution that also covers the full 48-to-860MHz TV bandwidth is presented in Paper 11.2 by NXP Semiconductors. The SiP uses a low-IF approach with discrete LC tracking filters. The 0.25µm BiCMOS die inside the SiP has smaller die area than either Paper 11.1 or 11.3. Power consumption is 750mW, and good image rejection is achieved with an auto-calibration technique. Paper 11.3 from Microtune employs a dual-conversion architecture with external filters that not only covers the full 48-to-860MHz TV bandwidth but also extends the range to a full 1GHz for compatibility with next generation CATV systems. The 0.35µm SiGe BiCMOS die is slightly larger than that of Paper 11.2 and consumes 1.5W. It achieves excellent image rejection, adjacent channel rejection, and fully loaded cable performance.

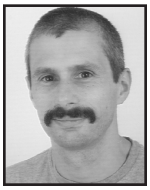
An RF tuner plus baseband demodulator chipset for ISDB-T mobile TV reception is presented in Paper 11.4 by Sharp. The RF tuner covers the 470-to-770MHz UHF bandwidth. Nominal power consumption for the chipset is a mere 105mW and compsumption as low as 77mW is demonstrated in the absence of strong interferers using an adaptive power control technique. The tuner uses 0.5µm BiCMOS while the baseband demodulator uses 0.13µm CMOS.

The use of near-field radio frequency identification (RFID) systems based on inductive coupling is gaining momentum in a wide variety of applications such as supply-chain management, anti-fraud solutions, and object tracking systems. UHF RFID systems operating at 900MHz has extended range and higher data rates compared to traditional lower frequency RFIDs at 125kHz and 13.56MHz. The main challenge in the design of RFID reader is to receive weak signals while transmitting a 20 to 30dBm CW signal to power the passive RFID tags. This session includes three highly integrated UHF RFID papers that can receive weak signals in the presence of large CW blocker without requiring highly selective off-chip filters. A UHF RFID transceiver implemented in 0.18µm BiCMOS technology is described in Paper 11.5 by Intel and Catena. This transceiver features a 20dBm power amplifier and an I/Q receiver with -83dBm sensitivity in the presence of a 0dBm blocker. A 0.18µm CMOS UHF RFID transceiver is presented in Paper 11.6 by Samsung and Kwangwoon U. This transceiver has a die size of 23.8mm^2, 18.5dBm IIP3, and 4dBm transmit power. Finally, in Paper 11.7 from UC Irvine, a novel receiver topology that can handle a large CW jammer is presented. This design employs two parallel paths, an LNA, and a limiter, to receive an incoming signal. The CW jammer is extracted by the limiter and then removed from the LNA output.

11.1 A 48-to-860MHz CMOS Direct-Conversion TV Tuner **8:30 AM**

S. Lerstaveesin, Chrontel, San Diego, CA

A single-chip TV-tuner IC receives terrestrial or cable-TV signals in the 48 to 860MHz frequency range without off-chip harmonic rejection and image filters. The midband sensitivity is -86dBm for 8-VSB ATSC signal with BER $<10^{-3}$, and the MER is 31.5dB when receiving J.83/B 256-QAM constellation from actual cable. A 5×5mm^2 chip, implemented in 0.18µm CMOS, consumes 750mW (540mW analog) at 1.8V supply.



11.2 A SiP Tuner with Integrated LC Tracking Filter for both Cable and Terrestrial TV Reception **9:00 AM**

V. Fillatre, NXP Semiconductors, Caen, France

A SiP tuner is designed for both terrestrial and cable reception of all analog and digital TV standards. It has 5dB of NF over the 48 to 862MHz frequency band. LC tracking filters allow for achieving 55dB weighted video SNR in loaded spectrum conditions. The active die, implemented in a 40GHz-f_t BiCMOS process, occupies 5.7mm^2 and consumes 750mW.

11.3 A Multi-Standard Analog and Digital TV Tuner for Cable and Terrestrial Applications **9:30 AM**

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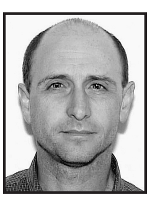
J-M. Stevenson, Microtune, Plano, TX

A TV tuner fully compliant with ATSC, NTSC, PAL, SECAM, DVB-T, ISDB-T and DMB-T/H standards is described. An array of power detectors and fine-step-size digital gain controls are used to achieve an optimum signal-path gain. The tuner achieves an input sensitivity of better than -84dBm for ATSC digital off-air signals. Implemented in a 0.35µm SiGe BiCMOS process, it occupies 7.3mm^2 and consumes 1.5W from a split 5V/3.3V supply.

11.4 A Digital TV Receiver RF and BB Chipset with Adaptive Bias-Current Control for Mobile Applications **10:15 AM**

T. Sakai, Sharp, Osaka, Japan

An ISDB-T 1-segment RF and BB chipset with adaptive bias-current control is presented. The BB IC monitors MER and dynamically sets the bias current of RF sub-circuits. In the worst reception case, the chipset consumes 105mW. In the absence of strong interferences, the adaptive control reduces the consumption down to 77mW without performance degradation.



11.5 A 900MHz UHF RFID Reader Transceiver IC **10:45 AM**

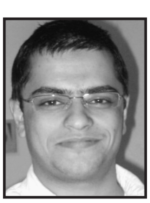
I. Kipnis, Intel, Berkeley, CA

A single-chip transceiver for worldwide multi-class UHF RFID readers integrates all RF and analog baseband blocks, a synthesizer, $\Delta\Sigma$ DACs and ADCs, digital filters and modem functions. The output power is up to +20dBm. Sensitivities down to -85dBm can be achieved in the presence of a 0dBm self-jammer. Total power consumption is 1.5W.

11.6 A Single-Chip CMOS Transceiver for UHF Mobile RFID Reader **11:15 AM**

I. Kwon, Samsung, Yongin, Korea

A UHF mobile RFID single-chip reader is implemented in a 0.18µm CMOS technology. The reader IC integrates an RF transceiver, a digital baseband modem, an MPU, and host interfaces in 4.5×5.3mm^2. The RF transceiver draws 61mA from a 1.8V supply and achieves an 8dBm P_{1dB}, an 18.5dBm IIP3, and a 4dBm TX power.



11.7 An Integrated RFID Reader **11:45 AM**

A. Safarian, University of California, Irvine, CA

A UHF RFID reader that handles RFID tag information as weak as -80dBm along with large inband blockers as large as 20dBm is presented. Fabricated in a 0.18µm CMOS process, the reader selectively attenuates large inband blockers, 40 to 250kHz away from the tag information, by better than 30dB using the limiting concept, while amplifying the tag information by 18dB.